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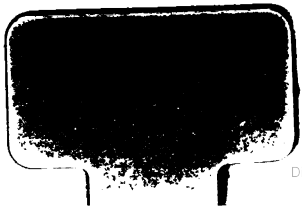

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THE

"MATHER-THOMPSON"

PATENT

Bleaching Process,

Based on PATENTS of WILLIAM MATHER, ENGINEER, SALFORD IRON WORKS, MANCHESTER, Nos. 7909, 1884; 471, 1912, 3096, 3748, 8793, 8794, &c., 1885;

And the PATENTS of JACOB BAYNES THOMPSON, Chemist, New Cross, Kent, No. 595, 1883, and No. 4707, 1884.

ENTERED AT STATIONERS' HALL.

MANCHESTER:
PALMER AND HOWE, PRINTERS, PRINCESS STREET.

1885.

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THE

"Mather-Thompson" Patent Bleaching Process.

Based on Patents of William Mather, Engineer, Salford Iron Works, Manchester, Nos. 7909, 1884; 471, 1912, 3096, 3748, 8793, 8794, &c., 1885, and the Patents of Jacob Baynes Thompson, Chemist, New Cross, Kent, No. 595, 1883, and No. 4707, 1884.

N order to convey to technologists an exact estimate of the advantages of the **Mather-Thompson** system of bleaching, it will be well to recall the outlines of the methods which constitute the ordinary practice of the bleacher, with which, of course, it is to be contrasted. The bleaching of vegetable textile fabrics consists in the main of two operations: (1) Treatment with alkaline solutions of varying composition and concentration and at various temperatures, according to the raw material and the result which it is desired to produce upon it. (2) The whitening or bleaching operation

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proper, which is a process of removal by means of an oxidising agent of those foreign substances which survive the previous treatment. The agent employed for this purpose is almost exclusively a solution of bleaching powder (calcium hypochlorite).

The first of these operations is divisible into two distinct stages—*(a)* the cleansing of the fabric from the looser impurities present in the raw fibre, and the sizing materials added in the processes of spinning and weaving; *(b)* the saponification and consequent conversion into soluble derivatives of those fibre constituents—not cellulose—which are intimately associated with the cellulose, the basis and preponderating constituent of the raw cotton (or flax). In this second stage also we include the resolution of those lignified substances, *e.g.* the "motes" of cotton, and the "sprit" and straw of flax, which are associated as mechanical impurities with these fibres.

(a) Which we may call the *scouring* or *preparing* process need not come into special consideration here, as it is, or should be, common to both systems. It is the practice of some bleachers after singeing simply to wash the cloth, and after allowing to lie for some hours to enable the size and other loose impurities to become softened, to wash a second time previously to its being put into the lime kier. This treatment of scouring is reduced in some cases to a wash with hot water, or sometimes also to a short preliminary boil in a kier before the cloth is brought into contact with the alkali. The

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disadvantages of not scouring the cloth in an efficient manner are so well known to all bleachers on the ordinary system, that we need only call attention to the fact that the **Mather-Thompson** process in like manner is also assisted by a preliminary treatment of the cloth of this nature before the actual bleaching operations commence. It will be found in our detailed description of the new system that this cleansing operation has been provided for in a special way, though it is not claimed to be an essential feature of the process.

In cleansing the cloth, in fact, we employ the waste or spent alkaline liquors from the succeeding process, and the treatment is therefore most economical.

The removal of the impurities in question—which are for the most part easily oxidisable, more especially so in contact with alkalies, and yield highly coloured brown products of oxidation—not only facilitate the bleaching, but the means by which it is accomplished renders it economical in the further sense of relieving the alkali in the succeeding operation from unnecessary work, and limiting it to its more important functions, viz., the *saponification* and solution of those constituents of the natural fibre. This, which is the chief object of the bleaching process proper, we now proceed to consider.

(b) Saponification, as is well known, is a process of hydrolysis, a splitting up of a compound (molecule) by the introduction of the elements of water, and it is one of those processes in which time is an important factor; the decomposition of the substance in the mass is realised

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gradually. The time necessary for saponification varies with the temperature, composition, and concentration of the saponifying solution. The hydrolysis, or saponification of the non-cellulose constituents of vegetable fibres, requires a very careful adjustment of these several factors, in order that it may be confined to these and not extended to the cellulose; for the cellulose itself is included in the same order of compounds, differing only in degree of stability and power of resisting the action of hydrolytic and oxidising agents. Here, then, we have the common conditions of the problem of the isolation of cellulose from a vegetable fibre, always containing more or less of those constituents which we include in the convenient term *non-cellulose.*

The solution of this problem for the purposes of the textile arts, though various, are in essence only two in number. (1) The high-pressure boil, generally employed in bleaching cotton goods for printing. (2) The low-pressure or open boil, commonly adopted by the "white" or market bleacher of cottons, and by the linen bleacher.*

(1) The printer's bleacher does not require the same amount of whiteness that is necessary to the market or white bleacher. On the other hand, he requires a very thorough "bottoming" of the cloth, *i.e.*, every trace of impurity must be removed such as would in any way form a mordant whereby the topical colouring of the

* Although this description of the Mather-Thompson system is confined to its application to cotton, it is obvious that for linen goods the advantages will be even more important.

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fabric would be prejudiced, or the colours rendered uneven or impaired in their tone and brilliancy.

The necessity hitherto existing to use lime (and subsequently soda-ash) in the alkali treatment of the cloth, chiefly with high-pressure boiling, for the removal of the impurities, introduces the liability to lime stains and other irregularities which are a constant source of annoyance and loss. This is entirely obviated by the **Mather-Thompson** process.

(2) Market or white bleaching is a more complicated process, not only by the greater number of operations through which the result is attained, but by reason of the much wider range in texture and quality of the goods bleached in this department.

In the first alkaline treatment, divided into the two stages or processes of lime stewing and bowking in soda-ash, the cloth is not advanced to the condition in which the subsequent chemicing can produce the necessary degree of whiteness, *i.e.*, the full bleach. And, moreover, the motes are only very imperfectly broken down.

The cloth, therefore, has to undergo the "second round" as it is termed, consisting of a bowk in soda-ash, followed by the second and usually final chemicing. Sometimes even a third round is necessary. Bleachers in this department therefore rely upon a more gradual breaking down of the non-cellulose constituents, requiring a large number of operations, and involving, therefore, much handling of the cloth and considerable expenditure of time.

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On the other hand, those who are familiar with the methods of alkali treatment adopted by the paper maker, by means of which even such resistant substances as wood are converted at one operation into nearly pure cellulose, which may be readily bleached, will have anticipated the possibility of assimilating the alkali treatment of textiles to the same system, of course with due regard to the difference in the object to be attained.

This has indeed been realised in the **Mather-Thompson** system, in which the method of alkali treatment occupies a very prominent place.

From the description of this treatment to be subsequently given, as well as from a consideration of its results, it will be seen that by the duly regulated combination of familiar agencies, cotton goods of all kinds and textures may in the one treatment be entirely deprived of those fibre constituents which it is the object of this saponification process to dissolve and remove.

(2) The whitening or bleaching process proper is directed to the removal of the residue of non-cellulose impurity, the union of which to the cellulose is not overcome by the hydrolytic treatment. The disappearance of these discolouring constituents under the oxidising action of the bleaching solution, is attended with such striking results, that an observer is easily led to over estimate its importance, as compared with the work done in the alkaline treatment. Nothing we think can give a clearer conception of their relative importance than a study of the system expounded in this report. The whitening

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process as ordinarily practised is one of great simplicity, owing to the remarkable properties of the bleaching solution (calcium hypochlorite) employed. It is unnecessary to enter into this in detail, as the contrast with the method adopted in the **Mather-Thompson** system will be sufficiently obvious.

We now proceed to the consideration of the system, and we shall have no difficulty in showing that it conforms much more closely than any yet proposed to the requirements of the recognised principles, the general theory of bleaching processes which we have enunciated.

(1) *The Steamer-Kier Process.*—The effective agents in the saponification process are water, alkali, and heat. To bring these together upon the fibre in such a way as to produce the maximum result in the shortest time; this was the problem which has been successfully worked out. The process which has resulted, always considered for reasons before stated, as applied to the scoured cloth, consists essentially in (1) the application of the alkali in solution, and in its most effective form, viz., as caustic alkali to each portion of fibre in such quantity as to produce the complete result upon that portion. (2) The immediate and sustained application of heat in the most effective form of steam to the portion so treated. The cloth is in effect saturated with about twice its weight of a dilute solution of caustic soda (2° to 4° Tw. = 0.5 to 1 per cent Na_2O) at the boiling temperature, piled in a wagon of peculiar construction and rapidly transferred to the

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Steamer-Kier, where it is exposed to an atmosphere of steam, at 4 lbs. pressure, during a period of five hours.

The superiority of such a process over all boiling processes is so obvious that as a matter of theory it is not necessary to defend it. Many attempts have been made to realise such a process in practice, but hitherto without success.

The use of caustic soda alone in the one operation such as above described process, instead of lime and soda-ash in at least two boiling operations, with the accessory acid treatment, realises in a safe and economical manner a long-needed improvement in bleaching.

Not only are the boiling processes superseded, but by this treatment cotton cloth of all textures and weights is in the space of five hours thoroughly. and uniformly bottomed, the motes being entirely resolved, and the work required to be done in the subsequent chemicing is reduced to the theoretical minimum. The details of the treatment of the cloth whilst it is in the wagons and in the Steamer-Kier form an essential feature in this process, being adjusted as the result of a long experimental investigation to the production of uniform results upon the cloth in the mass, and to avoid any weakening of the fibre by excessive treatment, general or local. After the steaming has been continued for five hours a powerful wash in hot water is given to the cloth by means of a circulating pump before the cloth is removed from the Steamer-Kier, so that only a slight rinse is necessary through cold water

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on removing the cloth from the wagons previous to the subsequent treatment in bleaching powder solution.

(2) *The Bleaching or Whitening Process.*—The principle underlying the method of applying the bleaching powder solution, under the new system, has an important feature in common with that upon which the previous treatment is based, viz., the *topical* application and realisation of the effect of the reagent. To accomplish the latter as rapidly and completely as possible, the hypochlorous acid, which is the effective bleaching agent, requires to be set free from its combination with lime. The advantages of carbonic acid, which is the auxiliary reagent employed for the purpose, consists in its strong affinity for lime in the simplicity of its action, *i.e.*, in being limited to the setting free of hypochlorous acid, the actual bleaching agent, and in its gaseous condition, which enables the most perfect contact to be realised between the *nascent* hypochlorous acid resulting from its action, and the fibre constituents in the exposure of the cloth treated with the bleaching solution to the action of the gas. The whole result is that the bleaching action of the hypochlorite is completely realised within the space of a few seconds, and the obvious application of the result is a "continuous" process of saturating the cloth with the solution, removing the excess by squeezing, and passing it at once into a chamber containing the carbonic acid, which then has no difficulty in penetrating the cloth and effecting the decomposition in all its parts. Before considering the process in detail, as it is worked, we may upon this bare statement of its

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essential feature, point out its great advantage over the ordinary process of chemicing. In the latter a lengthened exposure to the oxidising action of the bleaching solution is required, for the two-fold reason that the unaided action of the hypochlorite is relatively slow, and that to produce the required result upon every portion of a mass of cloth, the whole has to be exposed during the time that the portion most unfavourably situated takes to attain the level of whiteness. Not only does this involve a relatively large expenditure of time, but however uniform the bleach may appear to be, the fibre will be variously oxidised according to the conditions of its exposure.

Those who have followed the researches of the late M. Witz and others, upon the modifications of cellulose by the action of oxidising agents, will at once recognise that this is a disadvantage which cannot be ignored, and its elimination under the improved system of chemicing above described, is a not unimportant feature of the improvement.

It is of course well known that the crude form of chemicing known as pit chemicing, has been to a great extent replaced, at least among printers and dyers by the process of machine chemicing, in which the cloth is evenly saturated with the chemic solution, squeezed, and allowed to lie for some time in the pile, that the bleaching action may complete itself. It is needless to point out that this method, though realising in part the advantages of that which we are considering, chiefly in regard to

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uniformity of action upon the cloth, it is still very much inferior as a method of economical chemicing, nor is the degree of whiteness attainable in the single treatment such as to have caused white bleachers to have abandoned the pit method in its favour. It is on the other hand to the white bleacher that the **Mather-Thompson** bleaching range will especially commend itself, since it enables him by the one operation, upon the continuous length of cloth, travelling at the rate of sixty to eighty yards per minute, to bring the cloth up to the high standard of the 'market' or white bleach. In order to render this a matter of certainty upon cloth of all textures and qualities, it has been found necessary to include a double treatment with the chemic and gas, each of thirty seconds' duration, with an intermediate scald in a boiling very dilute alkaline solution, thus imitating and in effect embodying the "second round," together with the first chemicing in the one operation. The order of treatment in the **Mather-Thompson** continuous bleaching machine is therefore as follows:

(1) Saturation with weak chemic (1° Tw.), squeeze and passage to gas chamber; (2) Wash (running); (3) Soda Scald; (4) Wash; (5) Repetition of (1), but with weaker chemic, (½° Tw.); (6) Wash; (7) Souring.

Thus far we have said nothing of the souring operation, which, it is unnecessary to point out, is as essential to this as to every other system of bleaching. The souring can either be included in the "continuous" operation, or it can be made a distinct treatment at pleasure. As, how-

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ever, it is common to all systems it is unnecessary here to enter into further detail.

It remains to be pointed out that in the case of yarns and heavy piece goods which cannot conveniently be treated on the "continuous" plan, a second method of chemicing is adopted, also based upon the use of carbonic acid as an auxiliary. The apparatus employed is an air-tight kier in conjunction with a gasholder, which is charged with the carbonic acid. By means of this apparatus the goods are alternately saturated with the chemic, and exposed to the atmosphere of carbonic acid, which is drawn over into the kier by the descent of the bleaching liquid into a tank beneath; this is then returned to the kier by a pump, which, at the same time, forces back the gas into the holder. The advantage of this treatment is that the goods may be fully bleached by the one operation, and the "second round" is therefore unnecessary.

Having now given the outlines of the **Mather-Thompson** system, and compared it with the methods in general use for cotton bleaching, in regard to conformity to the requirements of fundamental principles, we come to the more practical question of the advantages upon which the former claims the favourable consideration of bleachers.

To begin with, we annex a comparative diagram of the two systems as applied to market bleaching.

From this diagram the general economy of the **Mather-Thompson** system is sufficiently obvious, and upon the question of relative expenditure of time, as of handling

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O BLEACHING

" SYSTEM.

WORTH, SON, & Co., BOLTON.

Ac	*Acid.*	*Machine Washes.*
(1) { Sa { St		(1) Wash
	(2) Sour.	(2) Wash.
		(3) Wash.
		(4) Wash.
	(5) Sour.	(5) Wash.
		(6) Wash.
		(7) Wash.
	(8) Sour.	(8) Wash.

In
and (
hours nvolves eight treatments with
washin hings. Taking the average
hours and of the latter at one
ork during **40 hours.**

oth cases.)

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of the cloth, we need say nothing further. The direct advantages already, ascertained by the treatment of a large quantity of cloth sent into the market may be stated as follows :—

In regard to *consumption of chemicals*, the **saving** is, as near as we can estimate, at least *one-fourth* (*i.e.*, in money value); of *steam, i.e.*, coal, *one-half;* of *labour, one-half;* of *water, four-fifths;* of *time, two-thirds.* The first cost of plant and space required are much less than in the ordinary system; on the *collateral* advantages of the process, such as simplification of method and increased working facilities, and less handling and punishing of the cloth, we do not think it necessary to dwell.

With regard to the thoroughness and permanence of the bleach, it is not necessary to claim more than equality of result as compared with the ordinary system. This has been amply verified, not only by laboratory experiment, but by results obtained on a large scale with a full working plant at one of the most important bleach works in Lancashire, Messrs. Ainsworth, Son, & Co., whose manager, Mr. Manby, has conducted these exhaustive trials. These are open to the fullest investigation from outside. So also with the important question of the preservation of the integrity of the fibre. Upon this point we may cite a test of the strength of a yarn bleached by the **Mather-Thompson** process :

YARN SPUN FROM EGYPTIAN COTTON.

Description.	Count.	Breaking Strain. Average of six trials.	Condition.
Warp Twist.....	40's	50 lbs. per lea	..... Grey.
Warp Twist.....	41·66	50 lbs. per lea	..... Bleached.

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With this we bring our brief discussion of the **Mather-Thompson** process to a close. From the circumstances of our connection with the promoters of the system and the part we have taken in its development, we cannot perhaps avoid the appearance of advocacy or special pleading of its merits. We look to the endorsement of the process by our fellow technologists, and the future verdict of practical bleachers, as the best proof that we have not been actuated by any unsubstantial considerations, but have kept to the solid ground of accomplished fact.

(Signed)

C. F. CROSS & E. J. BEVAN,

Consulting Chemists to the Thompson Patent Bleaching Co. Ltd., the Proprietors of the patents of **W. Mather & J. B. Thompson.**

Sole Manufacturers and Agents for the

"Mather-Thompson"

System of Bleaching,

MATHER & PLATT,

Engineers,

SALFORD IRON WORKS,

Manchester.

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THE

"MATHER-THOMPSON"

PATENT

BLEACHING PROCESS.

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